

PRELIMINARY DATA SUMMARY

April 1990

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

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CERC Field Research Facility
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Michael W. Leffler at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

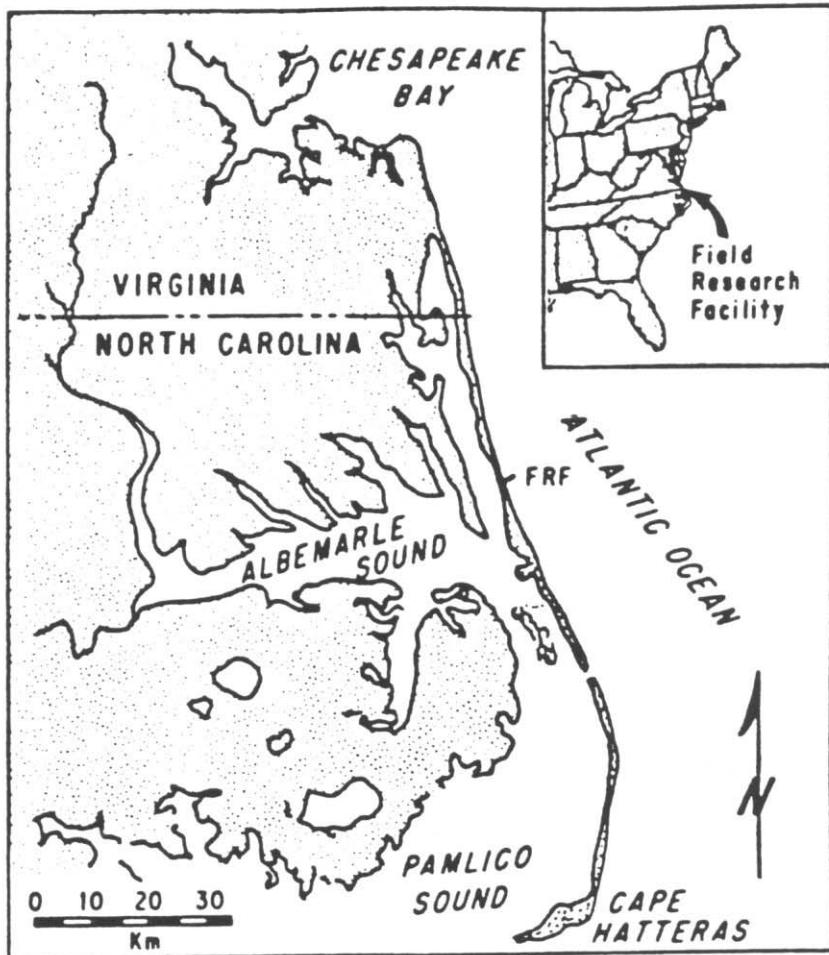


Figure 1. FRF location map

Table 1: Instrument Status/Data Availability

APR 1990

Gage ID	Description/Remarks	Depth at Sensor		Day of the month																														
				1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	
616	Barometric Pressure		Gage Status Data Collected Analog Record	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
604	Precipitation		Gage Status Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
624	Air Temperature		Gage Status Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
932	Anemometer at seaward end of pier Elevation 19 m (NGVD)		Gage Status Data Collected Analog Record	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
645	Baylor staff at station 7+80 on FRF pier	see Figure 7	Gage Status Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
625	Baylor staff at station 18+60 on FRF pier	see Figure 7	Gage Status Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
111	Pressure gage 309 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m NGVD	Gage Status Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
630	Waverider buoy 6.0 km offshore	Approx. 23 m NGVD	Gage Status Data Collected	/	/	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
519	Current meter 320 m north of FRF pier (0.9 km offshore)	see Figure 7	Gage Status Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
865-1370	NOAA tide station at seaward end of FRF pier		Gage Status Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Supplemental Observations (daily oceanographic and meteorological observations)		Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -

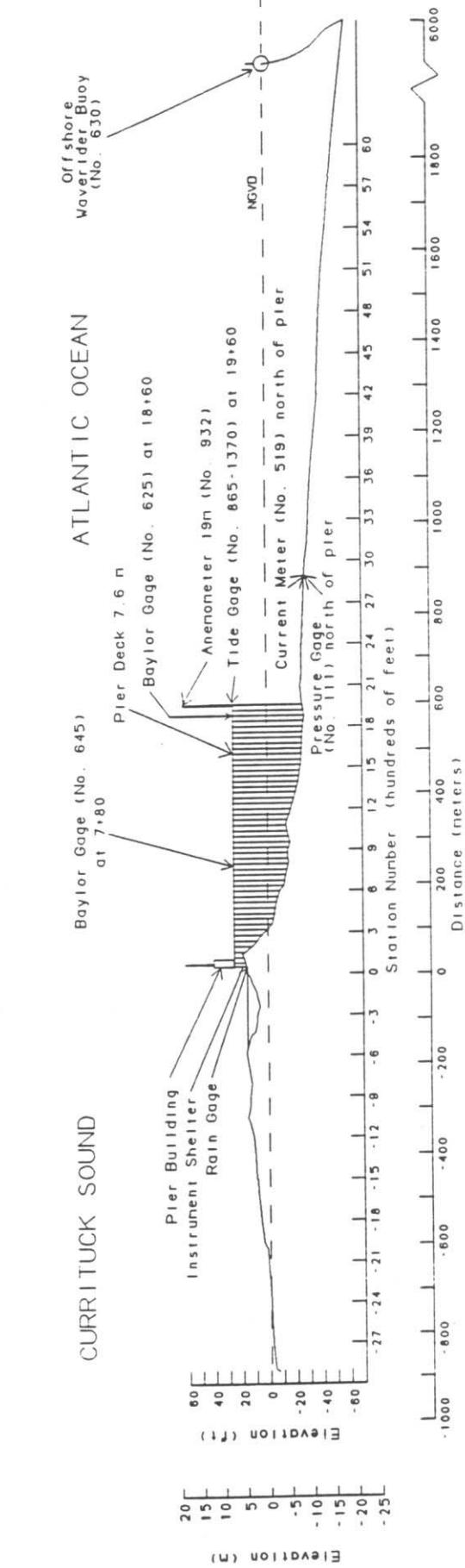
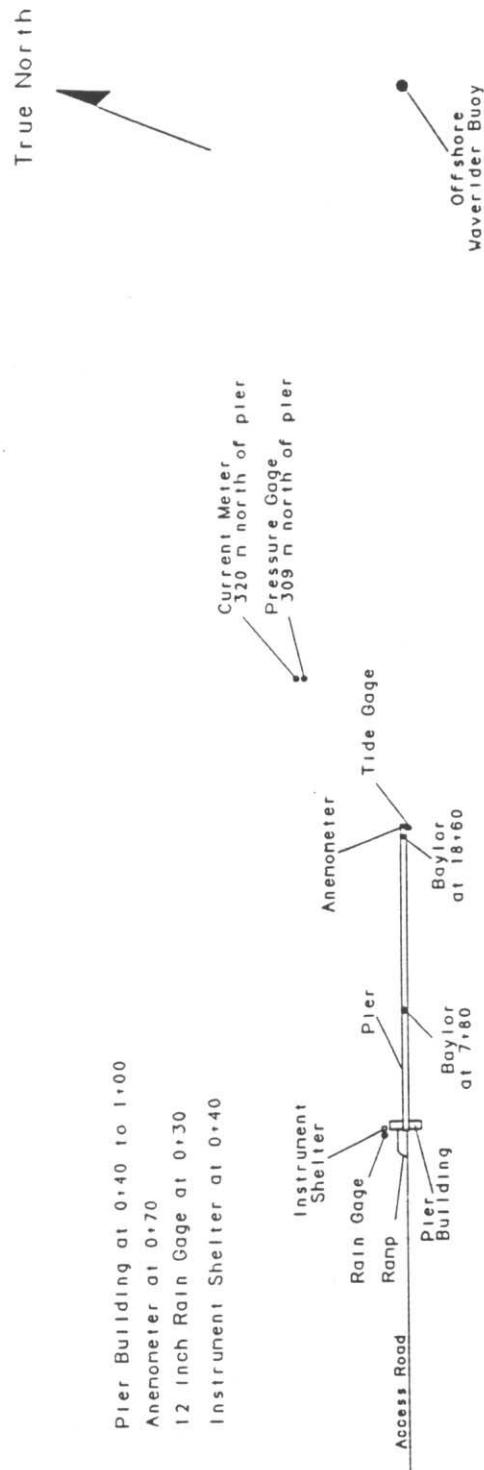


Figure 2. Instrument locations at FRF (all elevations from NGVD, all distances from FRF baseline).

PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

Table 2: Meteorological Data

Apr 1990

Day	Hour	Wind	Wind	Temperature	Atm	Precipitation
		Speed m/sec	Direction deg TN	deg C	Pressure mb	mm
1	100	7	356	9.2	1012.1	0
	700	7	8	8.8	1013.1	0
	1300	4	356	10.5	1013.1	0
	1900	4	81	9.6	1011.4	0
2	100	3	194	10.5	1011.8	0
	700	4	15	10.7	1011.1	0
	1300	5	109	11.7	1009.1	0
	1900	5	142	11.9	1005.4	0
3	100	6	231	16.1	1000.3	0
	700	10	338	10.3	1000.6	0
	1300	12	319	10.5	999.6	0
	1900	2	32	9.6	999.6	0
4	100	7	316	8.7	999.6	0
	700	9	281	6.5	1000.6	0
	1300	9	247	12.3	999.3	0
	1900	5	269	12.7	1001.0	0
5	100	4	214	11.1	1003.7	0
	700	7	265	12.8	1006.4	0
	1300	6	226	19.0	1007.7	0
	1900	7	184	15.7	1008.7	0
6	100	7	191	13.8	1009.4	0
	700	7	221	16.3	1010.8	0
	1300	10	24	11.1	1011.4	0
	1900	10	336	10.2	1008.1	3
7	100	8	346	8.7	1007.0	0
	700	13	332	5.4	1011.8	4
	1300	11	357	8.6	1014.8	0
	1900	5	66	7.2	1017.9	0
8	100	8	338	6.1	1021.3	0
	700	8	356	7.0	1025.3	0
	1300	4	59	9.6	1025.3	0
	1900	6	143	7.0	1026.3	0
9	100	2	157	6.8	1028.7	0
	700	3	155	10.8	1031.4	0
	1300	4	114	13.4	1031.4	0
	1900	6	135	10.9	1028.7	0
10	100	6	185	12.7	1026.3	0
	700	5	194	15.0	1024.3	0
	1300	9	184	21.8	1019.6	0
	1900	9	194	17.9	1014.2	0
11	100	11	188	17.6	1009.1	0
	700		Hardware Error			0
	1300	9	25	11.9	1005.0	37
	1900	4	346	9.8	1010.1	0
12	100	8	339	8.5	1015.5	0
	700	4	312	9.4	1018.6	0
	1300	4	84	12.9	1018.6	0
	1900	5	116	10.9	1020.6	0
13	100	7	34	9.5	1024.0	0
	700	9	38	8.6	1028.4	0
	1300	6	1	10.3	1029.1	0
	1900	7	78	8.8	1027.4	0
14	100	7	86	10.0	1027.0	0
	700	6	81	12.2	1026.3	0
	1300	6	103	14.3	1022.6	0
	1900	7	153	13.8	1019.2	0
15	100	7	167	16.2	1016.5	0
	700	3	150	13.0	1013.8	0
	1300	3	110	14.8	1012.1	7
	1900	2	94	12.8	1010.8	0
16	100	1	119	12.2	1011.1	0
	700	7	359	11.9	1013.1	0
	1300	7	19	13.4	1014.8	0
	1900	3	66	12.0	1014.5	0

* electronic problems

(Continued)

Table 2: Meteorological Data

Apr 1990

Day	Hour	Wind	Wind	Temperature	Atm	Precipitation
		Speed m/sec	Direction deg TN	deg C	mb	mm
17	100	2	108	11.9	1013.8	0
	700	5	239	17.8	1012.5	0
	1300	5	237	24.4	1009.4	0
	1900	15	357	13.2	1011.4	0
18	100	15	349	8.2	1019.9	2
	700	14	5	7.8	1025.3	0
	1300	9	17	8.4	1028.4	0
	1900	6	33	7.8	1029.1	0
19	100	6	56	8.4	1031.8	0
	700	9	50	10.0	1034.1	0
	1300	10	47	11.5	1034.8	0
	1900	8	58	10.7	1033.5	0
20	100	5	83	11.2	1032.1	0
	700	3	137	13.7	1031.4	0
	1300	6	121	17.8	1029.7	0
	1900	7	147	14.0	1026.0	0
21	100	7	197	15.1	1023.3	0
	700	8	199	16.5	1020.6	0
	1300	8	208	22.5	1015.5	0
	1900	6	199	17.3	1012.8	0
22	100	8	347	13.2	1013.1	19
	700	7	17	12.0	1015.9	0
	1300	8	4	13.1	1017.2	0
	1900	1	71	11.1	1016.5	0
23	100	3	201	10.3	1016.2	0
	700	4	268	14.3	1016.9	0
	1300	4	224	21.7	1016.5	0
	1900	5	174	18.0	1015.2	0
24	100	6	230	16.2	1015.9	0
	700	6	252	18.0	1017.2	0
	1300	4	240	26.6	1016.9	0
	1900	7	198	22.7	1015.5	0
25	100	7	230	19.3	1015.9	0
	700	5	257	19.8	1016.9	0
	1300	2	47	18.5	1016.5	0
	1900	5	152	16.9	1014.5	0
26	100	5	233	19.2	1013.1	0
	700	5	290	22.1	1013.5	0
	1300	2	42	23.9	1013.1	0
	1900	5	152	20.6	1012.5	0
27	100	5	214	21.2	1012.5	0
	700	4	257	22.8	1013.5	0
	1300	4	90	26.4	1013.1	0
	1900	5	162	20.7	1011.8	0
28	100	4	208	21.4	1012.1	0
	700	5	246	22.0	1013.5	0
	1300	6	140	24.2	1013.1	0
	1900	6	177	23.0	1012.5	0
29	100	5	154	18.3	1012.1	0
	700	7	265	16.1	1013.1	13
	1300	4	81	16.8	1013.1	0
	1900	7	156	19.1	1012.5	0
30	100	1	71	14.9	1013.8	0
	700	4	279	15.6	1015.2	4
	1300	4	47	17.2	1011.1	10
	1900	2	90	16.1	1011.1	0
		Resultant 0	Mean 14.0	Mean 1016.0	Total 99	

* electronic problems

(Sheet 2 of 2)

PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for four contiguous 34-min records.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all H_{mo} and T_p values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Apr 1990

Day	Hour	645		625		111		630	
		Baylor	at 7+80	Baylor	at 18+60	Pressure	Gage	Offsh	Wvdr
		Hmo,m	T,sec	Hmo,m	T,sec	Hmo,m	T,sec	Hmo,m	T,sec
1	0100	0.63	7.76	0.82	8.26	0.88	8.00	1.07	8.26
	0700	0.71	7.76	0.81	7.53	0.83	7.53	1.01	7.76
	1300	0.56	4.66	0.72	8.53	0.80	8.00	0.92	8.00
	1900	0.51	7.53	0.65	8.00	0.70	8.53	*	
2	0100	0.46	7.31	0.63	6.92	0.71	7.53	0.80	7.76
	0700	0.43	6.74	0.59	7.11	0.70	6.92	0.79	7.31
	1300	0.49	6.40	0.68	9.14	0.69	6.92	0.84	8.53
	1900	0.47	3.41	0.70	7.11	0.69	8.26	*	
3	0100	0.44	16.00	0.65	16.00	0.68	16.00	0.78	16.00
	0700	0.86	15.06	1.04	15.06	1.11	15.06	1.23	15.06
	1300	0.94	16.00	1.13	15.06	1.20	15.06	1.41	15.06
	1900	0.77	15.06	0.91	15.06	1.15	14.22	*	
4	0100	0.86	13.47	1.07	13.47	1.11	14.22	1.12	12.80
	0700	0.65	14.22	0.83	13.47	0.97	13.47	1.05	14.22
	1300	0.48	13.47	0.70	12.80	0.77	12.80	0.79	13.47
	1900	0.36	13.47	0.61	12.80	0.61	12.80	*	
5	0100	0.34	11.64	0.50	12.19	0.56	11.64	0.69	12.80
	0700	0.29	12.80	0.46	12.19	0.47	12.80	0.62	12.80
	1300	0.32	12.19	0.44	11.64	0.54	11.64	0.52	12.19
	1900	0.34	12.19	0.50	12.19	0.50	11.64	0.60	12.19
6	0100	0.27	11.64	0.44	11.64	0.50	12.19	0.55	11.64
	0700	0.29	11.64	0.42	11.64	0.49	11.64	0.62	11.13
	1300	0.65	3.28	0.71	11.13	0.67	3.37	0.81	11.13
	1900	1.06	5.12	1.02	5.22	1.13	5.22	1.27	5.22
7	0100	1.23	5.95	1.16	5.82	1.39	5.82	1.50	5.69
	0700	1.50	6.09	1.41	5.95	1.55	6.09	2.00	5.69
	1300	1.48	6.40	1.34	6.56	1.46	6.74	1.54	6.56
	1900	0.97	6.74	1.08	6.56	1.10	7.76	1.13	6.56
8	0100	1.02	8.83	1.02	9.48	1.16	8.53	1.25	8.26
	0700	0.98	9.14	1.05	9.14	1.10	8.83	1.18	8.83
	1300	0.77	5.02	0.82	8.00	0.92	8.00	0.98	7.76
	1900	0.51	5.22	0.66	8.53	0.71	8.53	0.75	8.53
9	0100	0.34	4.49	0.50	8.53	0.58	7.76	0.66	8.83
	0700	0.25	8.53	0.50	8.00	0.57	8.83	0.63	8.83
	1300	0.24	10.67	0.44	7.53	0.50	8.53	0.50	7.76
	1900	0.26	12.19	0.41	8.53	0.43	9.14	0.52	7.76
10	0100	0.26	11.64	0.41	10.67	0.44	8.26	0.51	6.92
	0700	0.29	4.66	0.44	11.64	0.50	4.13	0.52	4.66
	1300	0.44	3.12	0.47	12.19	0.48	3.28	0.68	4.49
	1900	0.46	5.45	0.58	5.69	0.61	5.45	0.83	5.22
11	0100	0.58	6.40	0.61	6.56	0.70	7.11	0.92	6.56
	0700				Hardware Error				
	1300	0.62	8.00	0.68	8.83	0.77	8.53	1.00	8.00
	1900	0.62	8.26	0.80	8.53	0.88	8.53	0.98	8.53
12	0100	1.50	5.95	1.23	5.69	1.26	5.45	1.61	5.69
	0700	0.65	8.53	0.77	8.83	0.82	8.53	0.96	8.83
	1300	0.46	8.53	0.61	8.83	0.68	8.53	0.76	8.53
	1900	0.51	8.00	0.69	8.53	0.73	8.26	0.85	8.53
13	0100	0.62	8.83	0.74	8.53	0.75	8.83	0.95	8.26
	0700	1.04	5.02	1.12	5.12	1.28	4.92	1.72	5.12
	1300	0.77	5.22	0.81	8.53	0.89	8.26	1.03	4.92
	1900	0.57	8.26	0.79	8.26	0.78	8.53	1.00	8.00
14	0100	0.63	4.06	0.80	7.76	0.79	7.76	0.91	9.48
	0700	0.62	4.49	0.75	9.48	0.79	9.48	0.97	7.53
	1300	0.56	4.49	0.70	8.83	0.75	9.48	0.86	8.83
	1900	0.46	8.53	0.69	9.14	0.76	9.14	0.87	8.53
15	0100	0.72	6.09	0.96	6.09	1.05	6.40	1.25	6.09
	0700	0.81	7.31	1.08	6.74	1.20	7.31	1.47	6.92
	1300	0.77	7.53	1.03	8.26	1.27	7.76	1.37	8.26
	1900	0.72	7.53	0.99	8.83	1.12	8.53	1.24	8.26
16	0100	0.56	7.53	0.80	8.83	0.91	8.00	1.05	8.26
	0700	0.46	7.11	0.66	8.26	0.71	8.53	0.87	8.26
	1300	0.50	8.83	0.70	8.53	0.69	8.26	0.83	8.26
	1900	0.55	8.53	0.75	8.53	0.75	9.14	0.90	8.26

* Electronic problems

(Continued)

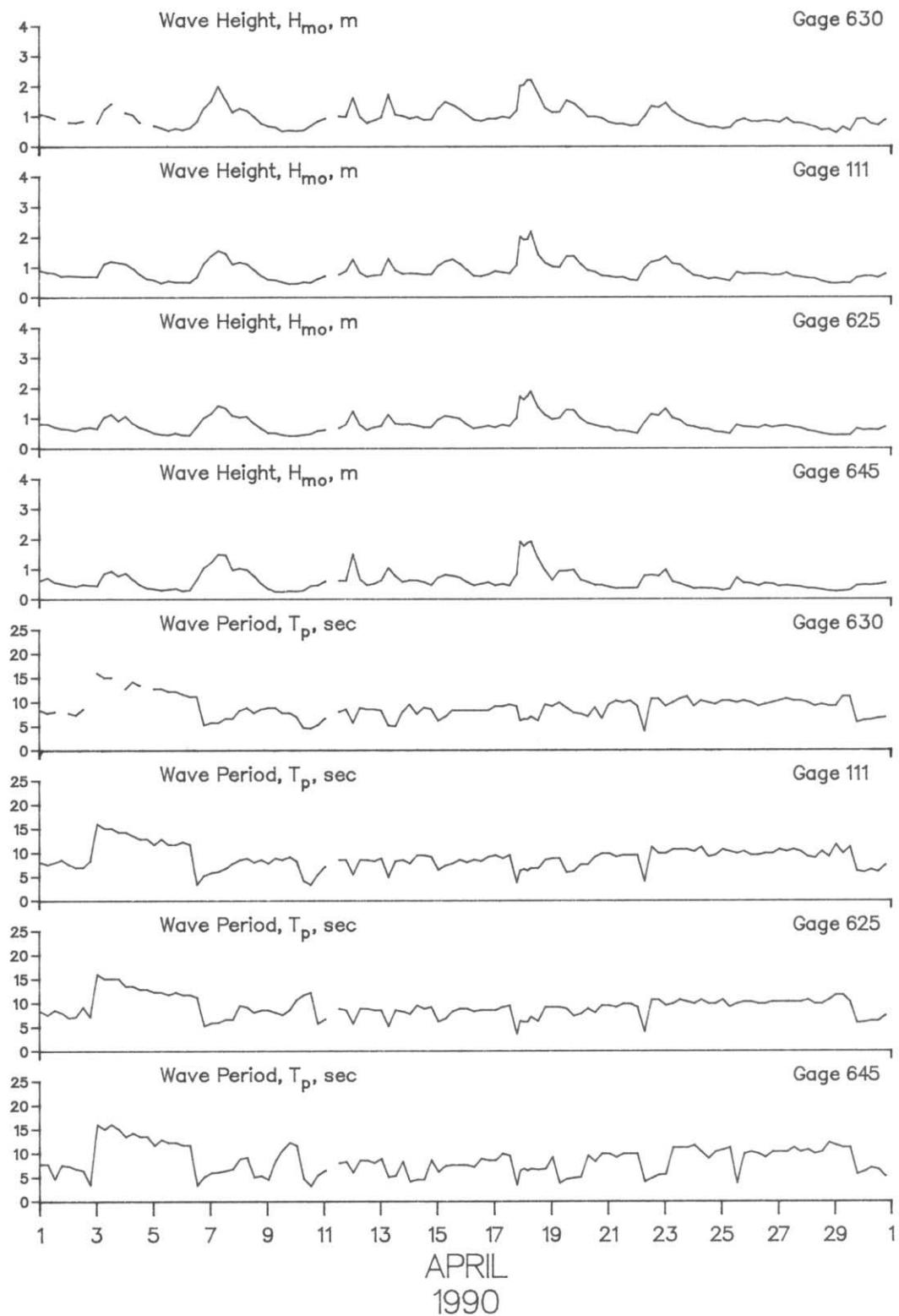
Table 3: Wave Data

Apr 1990

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo,m T.sec	Baylor at 18+60	Hmo,m T.sec	Pressure Gage	Hmo,m T.sec	Offshrd Wvrdr	Hmo,m T.sec
17	0100	0.45	8.53	0.70	8.53	0.86	9.48	0.90	9.14
	0700	0.50	9.85	0.78	9.14	0.82	8.83	0.98	9.14
	1300	0.45	9.48	0.74	9.48	0.79	9.48	0.93	9.48
	1900	0.82	3.37	1.00	3.56	1.07	3.77	1.18	9.14
18	0100	1.77	6.74	1.61	6.09	1.92	6.56	2.04	6.40
	0700	1.92	6.74	1.89	7.11	2.18	6.74	2.20	6.92
	1300	1.35	6.56	1.36	6.24	1.41	6.74	1.75	6.09
	1900	0.94	6.74	1.10	9.14	1.13	8.53	1.25	9.48
19	0100	0.63	9.14	0.96	9.14	1.01	8.83	1.12	9.14
	0700	0.93	3.71	0.99	9.14	0.99	8.83	1.12	9.85
	1300	0.94	4.57	1.28	8.83	1.36	5.82	1.51	8.83
	1900	0.98	4.83	1.27	7.31	1.37	6.09	1.42	7.76
20	0100	0.63	5.02	0.98	7.76	1.09	7.53	1.22	7.53
	0700	0.55	9.48	0.83	8.83	0.89	7.53	0.97	6.92
	1300	0.46	8.26	0.76	8.00	0.83	9.14	0.97	8.83
	1900	0.46	9.85	0.70	9.48	0.71	9.85	0.92	6.56
21	0100	0.39	9.85	0.69	9.48	0.69	9.85	0.78	9.48
	0700	0.34	9.14	0.57	9.14	0.64	9.14	0.73	10.24
	1300	0.35	9.85	0.58	9.85	0.65	9.48	0.73	9.85
	1900	0.35	9.85	0.53	9.85	0.57	9.48	0.67	10.24
22	0100	0.36	9.85	0.49	9.14	0.55	9.48	0.68	9.14
	0700	0.77	4.00	0.86	4.00	0.98	4.00	0.97	3.94
	1300	0.80	4.74	1.13	10.67	1.18	11.13	1.32	10.67
	1900	0.76	5.45	1.10	10.67	1.23	9.85	1.29	10.67
23	0100	0.98	5.57	1.32	9.48	1.36	9.85	1.44	9.14
	0700	0.57	11.13	1.00	9.85	1.11	10.67	1.15	9.85
	1300	0.51	11.13	0.93	10.67	1.08	10.67	0.99	10.67
	1900	0.42	11.13	0.75	10.24	0.88	10.67	0.84	11.13
24	0100	0.34	11.64	0.71	9.85	0.72	10.24	0.75	9.14
	0700	0.35	10.24	0.64	10.67	0.68	11.13	0.70	10.24
	1300	0.35	8.83	0.63	9.85	0.60	9.14	0.62	9.85
	1900	0.33	10.24	0.54	9.85	0.63	9.48	0.63	9.48
25	0100	0.28	10.67	0.52	10.67	0.59	10.67	0.57	10.24
	0700	0.33	11.13	0.47	9.14	0.54	10.24	0.61	10.24
	1300	0.71	3.71	0.77	9.85	0.83	9.85	0.83	9.85
	1900	0.53	9.85	0.71	10.24	0.77	10.24	0.90	10.24
26	0100	0.51	10.24	0.70	10.24	0.79	9.48	0.81	9.85
	0700	0.44	9.85	0.67	9.85	0.79	9.48	0.81	9.14
	1300	0.52	9.14	0.76	9.85	0.78	9.85	0.85	9.48
	1900	0.50	10.24	0.69	10.24	0.73	9.85	0.82	9.85
27	0100	0.42	10.24	0.74	10.24	0.74	10.67	0.78	10.24
	0700	0.44	10.24	0.75	10.24	0.81	10.24	0.92	10.67
	1300	0.42	11.13	0.70	10.24	0.70	10.67	0.76	10.24
	1900	0.40	10.24	0.66	10.24	0.67	10.24	0.75	10.24
28	0100	0.34	10.67	0.58	10.67	0.63	9.14	0.70	9.85
	0700	0.34	9.85	0.55	9.85	0.61	8.83	0.63	9.14
	1300	0.31	10.24	0.48	9.85	0.52	10.24	0.52	9.48
	1900	0.26	12.19	0.43	10.67	0.46	9.14	0.55	9.14
29	0100	0.24	11.64	0.42	11.64	0.44	11.64	0.44	9.14
	0700	0.25	11.13	0.42	11.64	0.47	9.85	0.63	11.13
	1300	0.29	11.13	0.42	10.24	0.46	11.13	0.51	11.13
	1900	0.44	5.57	0.65	5.82	0.65	6.09	0.89	5.69
30	0100	0.47	6.09	0.60	5.95	0.70	5.82	0.92	6.09
	0700	0.46	6.92	0.61	6.24	0.70	6.40	0.74	6.24
	1300	0.48	6.56	0.60	6.24	0.65	5.95	0.69	6.56
	1900	0.52	5.12	0.70	7.31	0.77	7.31	0.86	6.74
Mean		0.60	8.45	0.77	9.17	0.84	8.89	0.95	8.86
Std dev		0.32	2.98	0.27	2.25	0.30	2.37	0.34	2.25

* Electronic problems

(Sheet 2 of 2)



PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data
Apr 1990

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter			
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
1	0100-Along Cross Result										15	S
1	0700-Along Cross Result	47	S 9 on		140	3	N 2 off		12	S	8	off
1	1300-Along Cross Result	48	171			4	11				17	132
1	1900-Along Cross Result											
2	0100-Along Cross Result										11	S
2	0700-Along Cross Result	17	S 9 off		140	28	N 3 off		44	S	5	off
2	1300-Along Cross Result	19	133			28	346				12	136
2	1900-Along Cross Result										13	S
3	0100-Along Cross Result										4	off
3	0700-Along Cross Result	51	S 0		152	25	S 13 on		44	S	1	N
3	1300-Along Cross Result	51	160			28	187				6	off
3	1900-Along Cross Result										6	S
4	0100-Along Cross Result										7	on
4	0700-Along Cross Result	44	S 22 off		140	9	S 14 off		37	S	15	132
4	1300-Along Cross Result	49	133			17	104				13	146
4	1900-Along Cross Result										13	S
5	0100-Along Cross Result										4	off
5	0700-Along Cross Result	0				23	N 0		23	S	9	off
5	1300-Along Cross Result	23	off 70		140	23	23 340				13	142
5	1900-Along Cross Result										13	N

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

Table 4: Current Data (Continued)
Apr 1990

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter				
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	Depth -5.6m (NGVD)
6	0100-Along Cross Result										0		0.9 km Offshore
6	0700-Along Cross Result	15 23 27	N off 36		152	25 6 26	N off 354		14 S	South	4	on	5.6m (NGVD)
6	1300-Along Cross Result										6	off	Depth -5.6m (NGVD)
6	1900-Along Cross Result										9	119	ID #519
7	0100-Along Cross Result										23	S	
7	0700-Along Cross Result	51 8 51	S off 151		140	76 15 78	S off 149		38 S	South	15 40	off 139	
7	1300-Along Cross Result										27	S	
7	1900-Along Cross Result										9	off	
8	0100-Along Cross Result										28	142	
8	0700-Along Cross Result	51 0 51	S 140 160		41	S 8 41	S off 149		20 S	North	18 7 20	S off 140	
8	1300-Along Cross Result										7	S	
8	1900-Along Cross Result										5	off	
9	0100-Along Cross Result										9	124	
9	0700-Along Cross Result	44 0 44	N 140 340		30	N 15 34	N on 313		30 S	South	8 9 12	N on 292	
9	1300-Along Cross Result										4	N	
9	1900-Along Cross Result										8	on	
10	0100-Along Cross Result										9	277	
10	0700-Along Cross Result	41 20 45	N off 7		128	29 9 30	N off 357		9 N	South	5 6 8	N on 290	
10	1300-Along Cross Result										6	N	
10	1900-Along Cross Result										8	on	
											10	287	
											16	N	
											9	on	
											18	311	

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on = onshore off = offshore

Table 4: Current Data (Continued)
Apr 1990

Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter		
	Alongshore Cross-shore Resultant	Dye at (579 m) (surface)	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
11 0100-Along Cross Result									13	N	
									8	on	
									15	308	
11 0700-Along Cross Result	24	S			122	N		30	N		
	18	off	140		24	on					
	30	123			124	329					
11 1300-Along Cross Result									6	N	
									2	on	
									6	322	
11 1900-Along Cross Result									5	N	
									2	on	
									5	318	
12 0100-Along Cross Result									0		
									9	off	
									9	70	
12 0700-Along Cross Result	4	N			8	N		6	S	10	N
	5	on	140		2	off				0	
	6	290			8	354		North		10	340
12 1300-Along Cross Result										10	S
									0		
									10	160	
12 1900-Along Cross Result									5	S	
									2	off	
									5	138	
13 0100-Along Cross Result									24	S	
									12	off	
									27	133	
13 0700-Along Cross Result	38	S			24	S		51	S	25	S
	10	off	140		37	on		North		11	off
	39	146			44	216				27	136
13 1300-Along Cross Result									23	S	
									11	off	
									25	134	
13 1900-Along Cross Result									17	S	
									9	off	
									19	132	
14 0100-Along Cross Result									15	S	
									5	off	
									16	142	
14 0700-Along Cross Result	5	N			41	N		30	S	3	S
	11	on	140		18	on		South		2	on
	12	272			45	316				4	194
14 1300-Along Cross Result									9	S	
									0		
									9	160	
14 1900-Along Cross Result									1	S	
									1	on	
									1	205	
15 0100-Along Cross Result									2	S	
									3	on	
									4	216	
15 0700-Along Cross Result	4	N			76	N		69	N	1	N
	1	off	152		0			South		3	on
	4	354			76	340				3	268
15 1300-Along Cross Result									3	S	
									4	off	
									5	107	
15 1900-Along Cross Result									1	N	
									6	on	
									6	259	

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on = onshore off = offshore

Table 4: Current Data (Continued)
Apr 1990

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter			
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
16	0100-Along Cross Result										7	N
											3	on
											8	317
16	0700-Along Cross Result	4	S			55	N				8	N
		19	on		152	17	on				1	on
		19	238			58	323				8	333
16	1300-Along Cross Result										1	N
											13	off
											13	66
16	1900-Along Cross Result										2	N
											2	on
											3	295
17	0100-Along Cross Result										8	N
											1	on
											8	333
17	0700-Along Cross Result	20	S			25	N				14	S
		30	off		152	8	on				3	on
		37	104			27	323				14	172
17	1300-Along Cross Result										1	N
											1	on
											1	295
17	1900-Along Cross Result										10	S
											6	off
											12	129
18	0100-Along Cross Result										34	S
											10	off
											35	144
18	0700-Along Cross Result	76	S			122	S				26	S
		27	off		165	24	on				12	off
		81	141			124	171				29	135
18	1300-Along Cross Result										25	S
											10	off
											27	138
18	1900-Along Cross Result										13	S
											4	off
											14	143
19	0100-Along Cross Result										3	S
											0	
											3	160
19	0700-Along Cross Result	9	S			68	N				0	
		19	on		152	17	off				0	
		21	223			70	354				0	
19	1300-Along Cross Result										9	S
											13	off
											16	105
19	1900-Along Cross Result										23	S
											12	off
											26	132
20	0100-Along Cross Result										9	S
											0	
											9	160
20	0700-Along Cross Result	3	S			44	N				5	S
		0			165	0					4	off
		3	160			44	340				6	121
20	1300-Along Cross Result										5	N
											3	on
											6	309
20	1900-Along Cross Result										1	N
											2	on
											2	277

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Table 4: Current Data (Continued)
Apr 1990

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter			
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
21 0100-Along Cross Result											10	N
											7	on
											12	305
21 0700-Along Cross Result	32 13 35	N off 2			152	61 0 340			22	N	8 8 11	N on 295
21 1300-Along Cross Result											8 11 14	N on 286
21 1900-Along Cross Result											1 2 2	S on 223
22 0100-Along Cross Result											9 0 9	N 340
22 0700-Along Cross Result	12 5 12	S off 138			165	61 15 63	S off 146		20	S	1 3 3	S off 88
22 1300-Along Cross Result											4 2 4	N off 7
22 1900-Along Cross Result											8 3 9	S off 139
23 0100-Along Cross Result											4 10 11	N off 48
23 0700-Along Cross Result	24 24 34	S off 115			140	14 10 17	N off 17		20	N	16 4 16	S off 146
23 1300-Along Cross Result											8 0 8	S 160
23 1900-Along Cross Result											7 3 8	S off 137
24 0100-Along Cross Result											3 3 4	S on 205
24 0700-Along Cross Result	0 10 10				140	36 14 39	N off 2		5	N	1 2 2	N on 277
24 1300-Along Cross Result											3 0 3	N 340
24 1900-Along Cross Result											8 5 9	S on 192
25 0100-Along Cross Result											6 1 6	S on 169
25 0700-Along Cross Result	20 8 21	S off 138			140	9 7 12	S off 123		20	S	5 2 5	S off 138
25 1300-Along Cross Result											9 13 16	S off 105
25 1900-Along Cross Result											0 8 8	S on 250

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Table 4: Current Data (Concluded)
Apr 1990

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter	
		Dye at (579 m) (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	Speed
26 0100-Along Cross Result										0.9 km
		Speed	Dir							Offshore
										Depth -5.6m
										(NGVD)
										ID #519
26 0700-Along Cross Result	34 5 34	S on 169	140	12 0 12	S 160		18 S North			7 4 8 130
26 1300-Along Cross Result										9 13 16 105
26 1900-Along Cross Result										15 13 20 119
										3 1 3 178
27 0100-Along Cross Result										7 4 8 130
27 0700-Along Cross Result	8 17 19	S off 97	128	15 2 15	N on 331		11 N South			6 1 6 151
27 1300-Along Cross Result										10 4 11 138
27 1900-Along Cross Result										4 2 4 313
28 0100-Along Cross Result										12 3 12 146
28 0700-Along Cross Result	15 11 18	S off 123	152	0 2 2		30 N South				6 3 7 187
28 1300-Along Cross Result										8 4 9 133
28 1900-Along Cross Result										1 1 1 205
29 0100-Along Cross Result										1 0 1 160
29 0700-Along Cross Result	5 10 11	S on 223	140	2 0 2	S on 174		48 N South			3 4 5 213
29 1300-Along Cross Result										4 3 5 123
29 1900-Along Cross Result										5 1 5 171
30 0100-Along Cross Result										8 3 9 139
30 0700-Along Cross Result	3 7 8	S off 97	140	17 0 17	N 0 340		45 N South			6 2 6 142
30 1300-Along Cross Result										3 9 9 88
30 1900-Along Cross Result										0 3 3 250

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PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Apr 1990

Day	Time	Wave Approach		Radar Wave Angle deg from True N	Width of Surf Zone,m	Water Characteristics at Pier End		
		Primary	Secondary			Temp.,C	Density g/cc	Secchi Vis.,m
1	1110	100	45		59	11.1	1.0210	1.8
2	0823	65	110		37	10.9	1.0200	1.8
3	0800	95	20	85	73	10.6	1.0224	1.8
4	0737	100	45		59	10.6	1.0223	1.8
5	0615	120			49	10.6	1.0226	2.4
6	0700	80	140		6	11.1	1.0244	2.1
7	0848	50	25	50	76	11.7	1.0212	0.6
8	0725	50		55	49	11.1	1.0200	1.2
9	0756	75			44	11.4	1.0211	2.1
10	0748	80	120		5	11.1	1.0236	2.1
11	0730	90			46	11.1	1.0252	2.4
12	0740	105	10		49	11.1	1.0242	4.3
13	0740	25	75	80	81	11.7	1.0209	2.1
14	0925	55	95	60	67	12.0	1.0202	3.0
15	1010	100			78	11.7	1.0240	2.1
16	0740	90	20		82	12.2	1.0238	3.0
17	0740	85	65		66	13.3	1.0204	2.7
18	0740	30		60	226	11.7	1.0242	0.6
19	0700	80	55	90	91	11.4	1.0239	1.2
20	0805	65	105		90	13.6	1.0218	3.7
21	0925	90	115		84	12.2	1.0236	2.1
22	1003	95	15	90	93	12.8	1.0240	3.0
23	0530	80	45		87	13.3	1.0212	1.8
24	0550	45	105		58	13.0	1.0235	2.7
25	0810	30			43	12.8	1.0240	2.7
26	0740	90	40		52	16.7	1.0207	4.6
27	0735	55	80		64	17.8	1.0197	3.0
28	0835	60	115		26	17.2	1.0208	3.7
29	1100	85			20	16.9	1.0216	4.3
30	0735	95	125		52	15.3	1.0226	2.4

PART VI: WATER LEVELS

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

FRF Tide Heights

Apr 1990

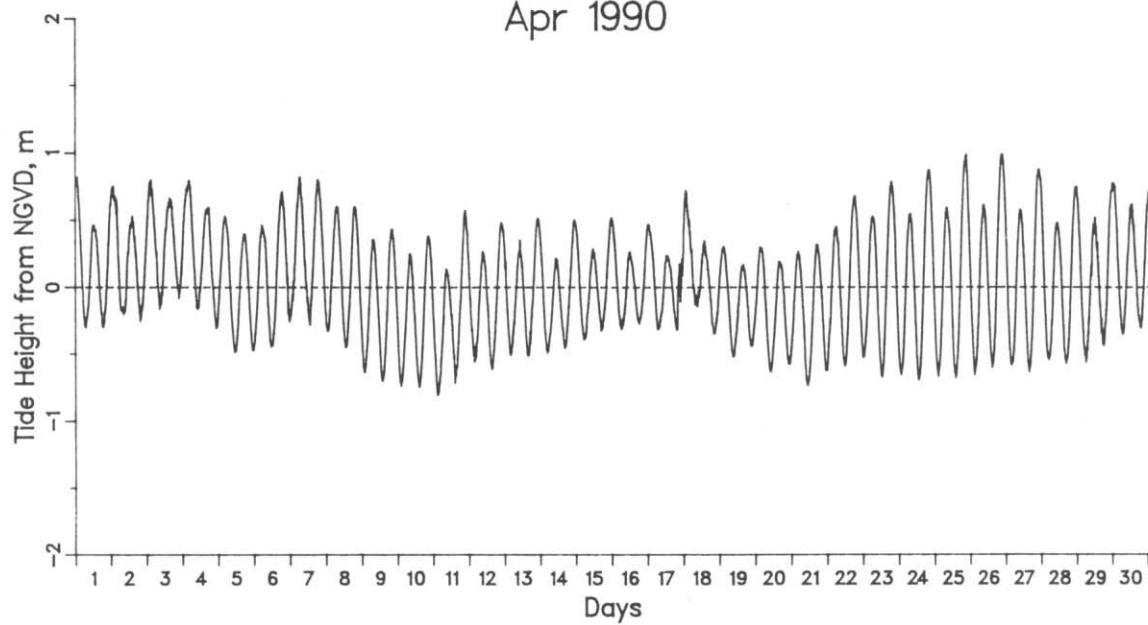


Figure 4. Water Level Time History

Monthly Water Levels, m NGVD

Extreme Low = -0.80 on day 11 at 148 EST
Extreme High = 0.99 on day 26 at 2024 EST
Monthly Mean = 0.03
Mean Low = -0.48
Mean High = 0.61
Mean Range = 1.09

Table 6: Water Levels, m NGVD

		Apr	1990		
Mid-Cycle Day	Time	Low	High	Mean	Range
1	612	-0.30	0.82	0.17	1.12
1	1837	-0.30	0.75	0.17	1.05
2	703	-0.20	0.69	0.20	0.89
2	1928	-0.25	0.79	0.21	1.04
3	753	-0.16	0.80	0.30	0.96
3	2018	-0.08	0.75	0.36	0.83
4	843	-0.16	0.80	0.27	0.96
4	2109	-0.31	0.60	0.15	0.91
5	934	-0.48	0.53	-0.02	1.01
5	2159	-0.48	0.46	-0.01	0.94
6	1024	-0.45	0.65	0.04	1.10
6	2249	-0.26	0.75	0.25	1.00
7	1115	-0.28	0.82	0.27	1.11
7	2340	-0.33	0.80	0.19	1.13
8	1205	-0.45	0.60	0.08	1.05
9	30	-0.64	0.60	-0.08	1.23
9	1255	-0.70	0.43	-0.16	1.13
10	121	-0.74	0.43	-0.19	1.17
10	1346	-0.75	0.38	-0.21	1.13
11	211	-0.80	0.36	-0.27	1.16
11	1436	-0.72	0.57	-0.14	1.29
12	301	-0.56	0.52	-0.09	1.08
12	1527	-0.61	0.48	-0.10	1.09
13	352	-0.51	0.43	-0.06	0.94
13	1617	-0.52	0.52	-0.03	1.03
14	442	-0.49	0.41	-0.10	0.90
14	1707	-0.46	0.50	-0.02	0.96
15	532	-0.39	0.40	-0.03	0.79
15	1758	-0.33	0.52	0.06	0.84
16	623	-0.32	0.41	0.00	0.72
16	1848	-0.28	0.47	0.06	0.75
17	713	-0.31	0.36	0.00	0.67
17	1938	-0.32	0.72	0.13	1.04
18	804	-0.14	0.52	0.14	0.66
18	2029	-0.35	0.30	-0.02	0.65
19	854	-0.52	0.24	-0.16	0.76
19	2119	-0.44	0.30	-0.08	0.74
20	944	-0.63	0.26	-0.20	0.90
20	2210	-0.58	0.26	-0.16	0.84
21	1035	-0.73	0.31	-0.23	1.05
21	2300	-0.62	0.45	-0.10	1.08
22	1125	-0.59	0.68	0.00	1.27
22	2350	-0.53	0.65	0.04	1.18
23	1216	-0.67	0.79	0.02	1.46
24	41	-0.66	0.72	0.00	1.38
24	1306	-0.69	0.87	0.04	1.57
25	131	-0.67	0.83	0.03	1.50
25	1356	-0.68	0.99	0.09	1.67
26	222	-0.66	0.94	0.05	1.60
26	1447	-0.60	0.99	0.14	1.59
27	312	-0.59	0.92	0.07	1.51
27	1537	-0.64	0.88	0.07	1.52
28	402	-0.55	0.83	0.05	1.37
28	1628	-0.57	0.75	0.03	1.33
29	453	-0.56	0.72	0.02	1.28
29	1718	-0.44	0.78	0.13	1.22
30	543	-0.35	0.77	0.17	1.12
30	1808	-0.31	0.73	0.16	1.04

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in March and the two surveys in April on profile line 188, located 517 m south of the pier. Significant changes on the foreshore (80 - 130 m) include early erosion followed by up to 0.5 m of accretion and the development of a berm. The nearshore bar (130 - 240 m) was leveled while offshore the storm bar migrated 20 m shoreward.

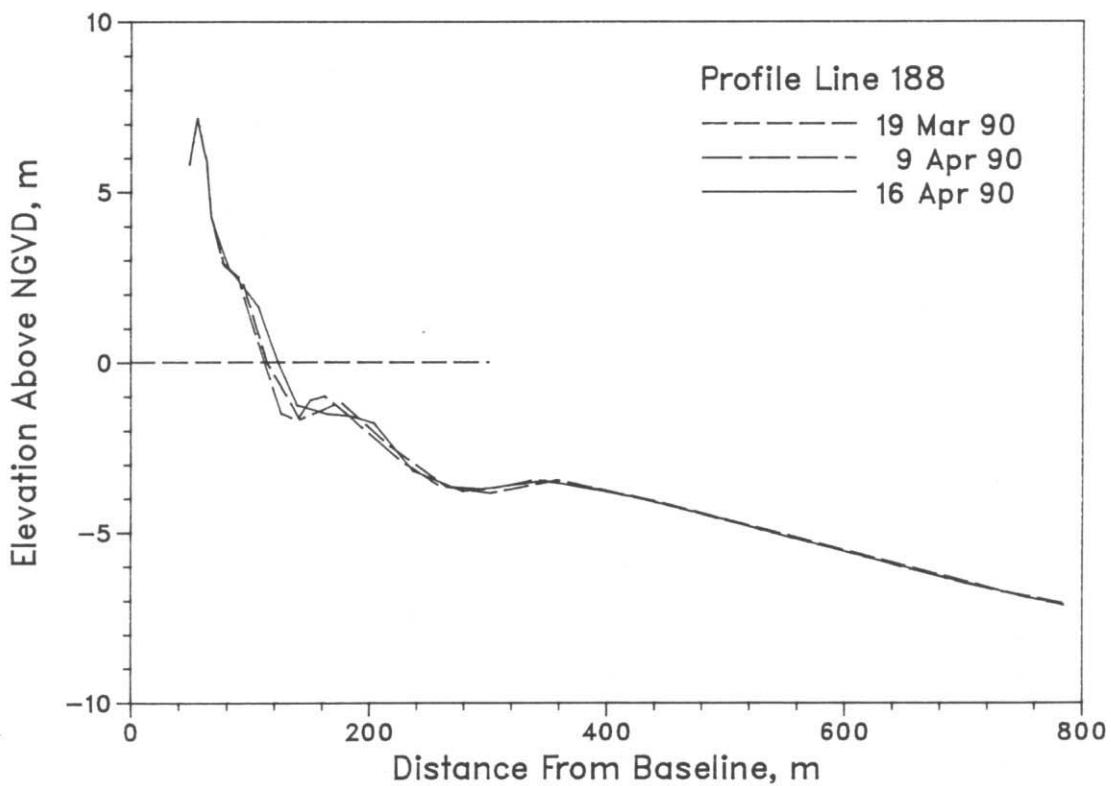


Figure 5. Monthly CRAB profiles on profile 188 -
517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1989. The early erosion, the development of the berm and the movement of the offshore bar are responsible for the changes visible on the envelope.

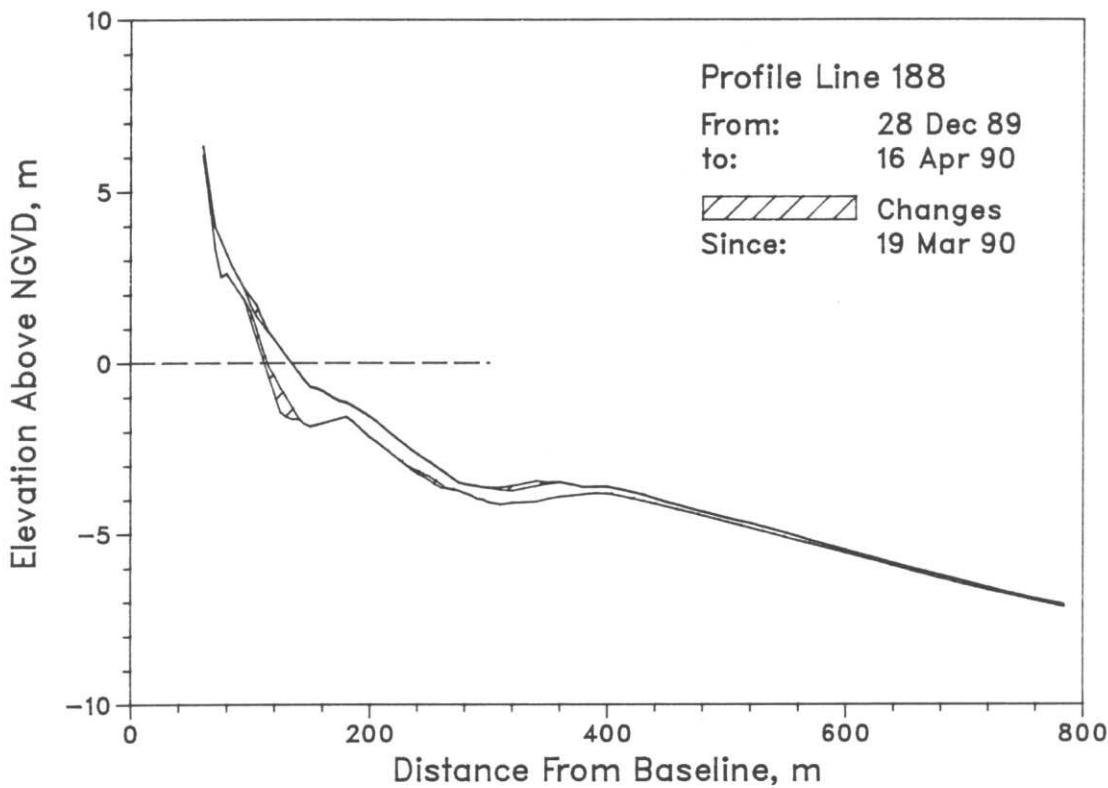


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 19 March (there was no bathymetric survey in April). Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

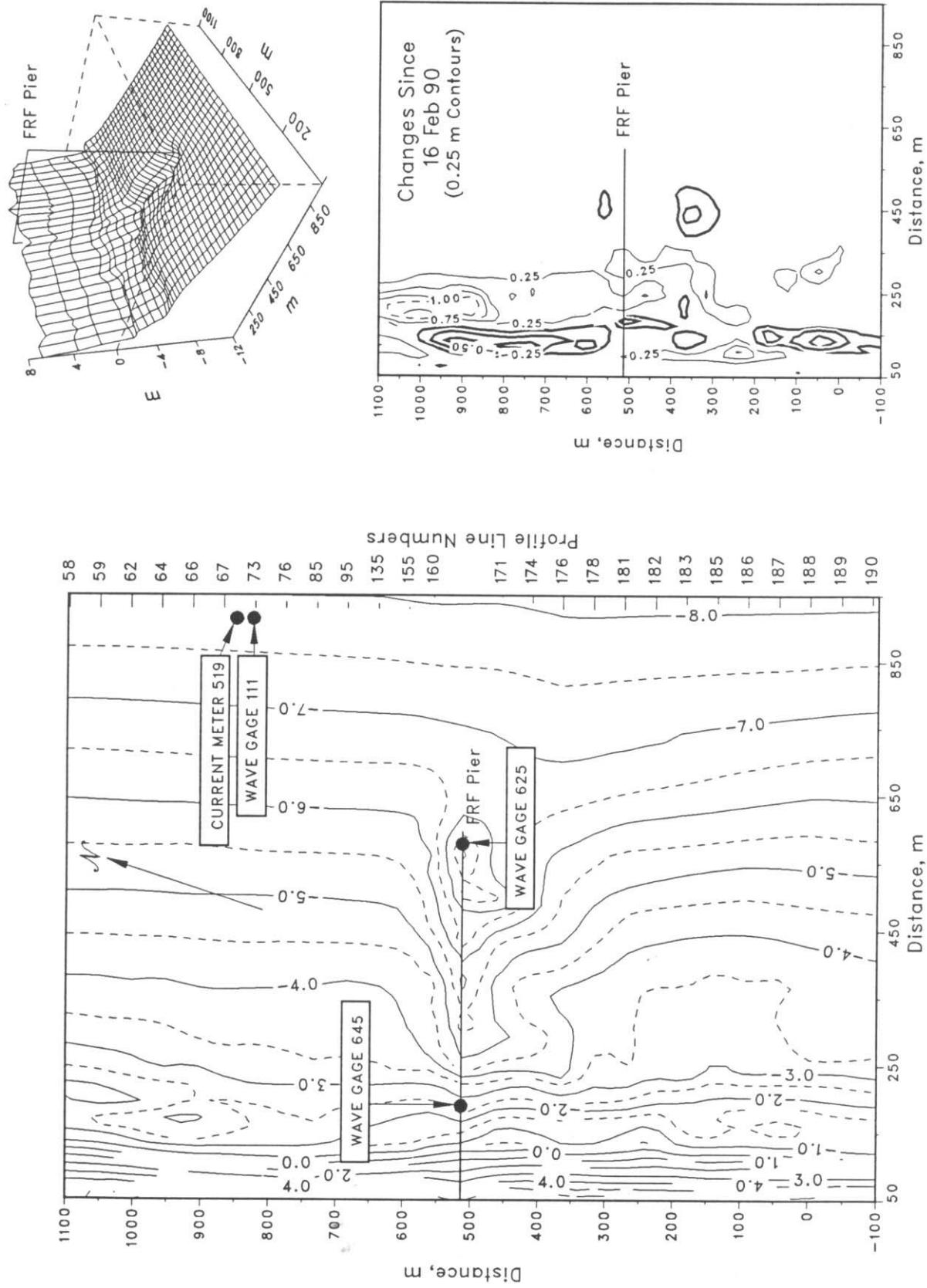


Figure 7. FRF bathymetry 19 Mar 90 depths relative to NGVD

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